



Physical Sciences

Image Quality Indicator for Infrared Inspections

John F. Kennedy Space Center, Florida

The quality of images generated during an infrared thermal inspection depends on many system variables, settings, and parameters to include the focal length setting of the IR camera lens. If any relevant parameter is incorrect or sub-optimal, the resulting IR images will usually exhibit inherent unsharpness and lack of resolution.

Traditional reference standards and image quality indicators (IQIs) are made of representative hardware samples and contain representative flaws of concern. These standards are used to verify that representative flaws can be detected with the current IR system settings. However, these traditional standards do not enable the operator to quantify the quality limitations of the resulting images, i.e. determine the inherent maximum image sensitivity and image resolution.

As a result, the operator does not have the ability to optimize the IR inspection system prior to data acquisition.

The innovative IQI described here eliminates this limitation and enables the operator to objectively quantify and optimize the relevant variables of the IR inspection system, resulting in enhanced image quality with consistency and repeatability in the inspection application.

The IR IQI consists of various copper foil features of known sizes that are printed on a dielectric non-conductive board. The significant difference in thermal conductivity between the two materials ensures that each appears with a distinct grayscale or brightness in the resulting IR image. Therefore, the IR image of the IQI exhibits high contrast between the copper features and the underlying dielectric board, which is re-

quired to detect the edges of the various copper features.

The copper features consist of individual elements of various shapes and sizes, or of element-pairs of known shapes and sizes and with known spacing between the elements creating the pair. For example, filled copper circles with various diameters can be used as individual elements to quantify the image sensitivity limit. Copper line-pairs of various sizes where the line width is equivalent to the spacing between the lines can be used as element-pairs to quantify the image resolution limit.

This work was done by Eric Burke of the United Space Alliance, Ground Operations Division, for Kennedy Space Center. Further information is contained in a TSP (see page 1). KSC-13484

Micro-Slit Collimators for X-Ray/Gamma-Ray Imaging

Goddard Space Flight Center, Greenbelt, Maryland

A hybrid photochemical-machining process is coupled with precision stack lamination to allow for the fabrication of multiple ultra-high-resolution grids on a single array substrate. In addition, special fixturing and etching techniques have been developed that allow higher-resolution multi-grid collimators to be fabricated.

Building on past work of developing a manufacturing technique for fabricating multi-grid, high-resolution coating modulation collimators for arcsecond and sub-arcsecond x-ray and gamma-ray imaging, the current work reduces the grid pitch by almost a factor of two, down to 22 microns. Additionally, a process was developed for reducing thin, high-Z (tungsten

or molybdenum) from the thinnest commercially available foil (25 microns thick) down to ≈ 10 microns thick using precisely controlled chemical etching.

This work was done by Michael Appleby, Iain Fraser, and Jill Klinger of Mikro Systems Inc. for Goddard Space Flight Center. For further information, contact the Goddard Innovative Partnerships Office at (301) 286-5810. GSC-15628-1

Scatterometer-Calibrated Stability Verification Method

This method can be used in microwave remote sensing, telecommunications, and in reconnaissance and homeland security applications.

NASA's Jet Propulsion Laboratory, Pasadena, California

The requirement for scatterometer-combined transmit-receive gain variation knowledge is typically addressed by sampling a portion of the transmit signal, attenuating it with a known-stable attenuation, and coupling it into the receiver

chain. This way, the gain variations of the transmit and receive chains are represented by this loop-back calibration signal, and can be subtracted from the received remote radar echo. Certain challenges are presented by this process,

such as transmit and receive components that are outside of this loop-back path and are not included in this calibration, as well as the impracticality for measuring the transmit and receive chains' stability and post fabrication separately,